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(54) **ELECTRICAL TERMINAL SEAL AND ELECTRICAL CONNECTOR CONTAINING SAME**

DICHTUNG FÜR ELEKTRISCHEN ANSCHLUSS UND ELEKTRISCHER STECKVERBINDER DAMIT
JOINT D'ÉTANCHÉITÉ DE TERMINAL ÉLECTRIQUE ET CONNECTEUR ÉLECTRIQUE LE
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Description

[0001] The present invention relates generally to electrical connectors and more particularly to sealed electrical connectors having terminals sealed to the connector housing.

[0002] Electrical connectors may include sealing elements to inhibit ingress of environmental contaminants, e.g. dust, dirt, water, or other fluids, into the connector body that may degrade the electrical properties of the terminals. In electric vehicle charging connectors, such as those conforming to Society of Automotive Engineers (SAE) J1772, international Electrotechnical Commission (IEC) 62196, Japan Automobile Research Institute CHAdeMo, or Goubiao/T (GBT) 20234.1 standards, this sealing is important due to the high voltages carried through the connector and the outdoor operating environment the connector is expected to endure. The high voltage terminals in these connectors are typically sealed by individual O-ring type seals.

[0003] Examples of electrical connectors having a sealing element are disclosed in publications DE 10 2016 107401 A1 and EP 1 791 223 A2.

[0004] The subject matter discussed in the background section should not be assumed to be prior art merely because of its mention in the background section. Similarly, a problem mentioned in the background section or associated with the subject matter of the background section should not be assumed to have been previously recognized in the prior art. The subject matter in the background section merely represents different approaches, which in and of themselves may also be inventions.

[0005] The application is directed to an electrical connector assembly that comprises the features of independent claim 1. Further examples are the subject matter of the dependent claims.

[0006] The present invention will now be described, by way of example with reference to the accompanying drawings, in which:

FIG. 1 is a perspective view of a subassembly of an electrical connector assembly according to some embodiments;

FIG. 2 is an exploded view of the subassembly of FIG. 1 according to some embodiments;

FIG. 3 is a perspective view of an electrical terminal seal of the subassembly of Fig. 1 according to some embodiments; and

FIG. 4 is cross section view of the subassembly of Fig. 1 according to some embodiments.

[0007] Reference will now be made in detail to embodiments, examples of which are illustrated in the accompanying drawings. In the following detailed description, numerous specific details are set forth to provide a thor-

ough understanding of the various described embodiments. However, it will be apparent to one of ordinary skill in the art that the various described embodiments may be practiced without these specific details. In other instances, well-known methods, procedures, components, circuits, and networks have not been described in detail so as not to unnecessarily obscure aspects of the embodiments.

[0008] FIGs. 1 and 2 illustrate a non-limiting example of an electrical connector assembly 100 used to charge an electrical vehicle. The electrical connector assembly 100 includes several generally cylindrical electrical terminals 106 having and an electrical terminal seal 10 configured to seal 10 the terminals 106 to a housing 102 of the connector assembly 100. As best shown in FIG. 3, the electrical terminal seal 10 includes a base 12 formed of a compliant material and several cylindrical protrusions 14 that are integrally formed with the base 12 and extend from a major surface 16 of the base 12. Each protrusion 14 defines a cylindrical terminal aperture 18 that extends through the protrusion 14 in which one of the terminals 106 is received. The first portion of the terminals 106 may have different diameters than a second portion of the terminals 106 and a corresponding first portion of the protrusions 14 may also have different diameter than a corresponding second portion of the protrusions 14.

[0009] Each protrusion 14 includes a first pair of circumferential ribs 20 that are integrally formed with the protrusion 14. As illustrated in FIG. 4, the first pair of ribs 20 extend into the terminal aperture 18 from an inner surface 22 of the protrusion 14 and are in an interference fit with the terminal 106 to provide compressive contact with a cylindrical portion 108 of the terminal 106. The first pair of ribs 20 provide an environmental seal to inhibit the ingress of environmental contaminants, such as dust, dirt, water, or other fluids, into the housing 102 through the terminal aperture 18.

[0010] Each of the protrusions 14 is disposed within a terminal cavity 104 of the housing 102 and the electrical terminal 106 is disposed within the aperture 18. The seal 10 further includes a second pair of circumferential ribs 24 that are integrally formed with the protrusion 14. The second pair of ribs 24 extends from an outer surface 26 of the protrusion 14 and are in an interference fit with a wall 110 of the terminal cavity 104 to provide compressive contact with the wall 110 of the terminal cavity 104. The second pair of ribs 24 provide an environmental seal configured to inhibit the ingress of environmental contaminants into the housing 102 through the terminal cavity 104.

[0011] The second pair of ribs 24 are arranged on the outer surface 26 of each protrusion 14 opposite a location of the first pair of ribs 20 on the inner surface 22 of each protrusion 14. Each rib in the first and second pair of ribs 20, 24 has the same circular segment cross section, preferably a semicircular cross section.

[0012] The base 12, each protrusion 14, each first pair of ribs 20, and each second pair of ribs 24 are integrally

formed of the same compliant material. The compliant material may be a self-bleeding, low compression set silicone rubber having a Shore A durometer value in a range of 15 to 23, preferably in a range of 18 to 20, and more preferably having a value of 18.

[0013] Although the example of the terminal seal 10 shown here has a pair of first and second ribs 20, 24 on each protrusion 14, alternative embodiments of the terminal seal may be envisioned having single first and second ribs, more than two first and second ribs, only a first rib on the inner surface of the aperture, or only a second rib on the outer surface of the protrusion.

[0014] While the example presented is an electrical connector assembly, alternative embodiments of the connector assembly and/or seal may be envisioned that are configured to interconnect fiber optic cables, pneumatic tubes, hydraulic tubes, or a combination thereof.

[0015] Accordingly, an electrical terminal seal 10 and an electrical connector assembly 100 is provided. The seal 10 provides the benefits of sealing multiple electrical terminals 106 to a connector housing 102 with the sealing efficiency of individual O-ring seals without the labor required to separately apply an O-ring seal to each terminal.

[0016] While this invention has been described in terms of the preferred embodiments thereof, it is not intended to be so limited, but rather only to the extent set forth in the claims that follow. For example, the above-described embodiments (and/or aspects thereof) may be used in combination with each other. In addition, many modifications may be made to configure a situation or material to the teachings of the invention without departing from its scope. Dimensions, types of materials, orientations of the various components, and the number and positions of the various components described herein are intended to define parameters of certain embodiments and are by no means limiting and are merely prototypical embodiments.

[0017] As used herein, 'one or more' includes a function being performed by one element, a function being performed by more than one element, e.g., in a distributed fashion, several functions being performed by one element, several functions being performed by several elements, or any combination of the above.

[0018] It will also be understood that, although the terms first, second, etc. are, in some instances, used herein to describe various elements, these elements should not be limited by these terms. These terms are only used to distinguish one element from another. For example, a first contact could be termed a second contact, and, similarly, a second contact could be termed a first contact, without departing from the scope of the various described embodiments. The first contact and the second contact are both contacts, but they are not the same contact.

[0019] The terminology used in the description of the various described embodiments herein is for the purpose of describing embodiments only and is not intended to be limiting. As used in the description of the various de-

scribed embodiments and the appended claims, the singular forms "a", "an" and "the" are intended to include the plural forms as well, unless the context clearly indicates otherwise. It will also be understood that the term "and/or" as used herein refers to and encompasses all possible combinations of one or more of the associated listed items. It will be further understood that the terms "includes," "including," "comprises," and/or "comprising," when used in this specification, specify the presence of stated features, integers, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof.

[0020] As used herein, the term "if" is, optionally, construed to mean "when" or "upon" or "in response to determining" or "in response to detecting," depending on the context. Similarly, the phrase "if it is determined" or "if [a stated condition or event] is detected" is, optionally, construed to mean "upon determining" or "in response to determining" or "upon detecting [the stated condition or event]" or "in response to detecting [the stated condition or event]," depending on the context.

[0021] Additionally, while terms of ordinance or orientation may be used herein these elements should not be limited by these terms. All terms of ordinance or orientation, unless stated otherwise, are used for purposes distinguishing one element from another, and do not denote any order of operations, direction, or orientation unless stated otherwise.

Claims

1. An electrical connector assembly (100), comprising:
 - a connector housing (102) defining a cylindrical terminal cavity (104);
 - an electrical terminal (106) having a cylindrical portion (108); and
 - an electrical terminal seal (10) formed of a self-bleeding, low compression set silicone rubber having a Shore A durometer value in a range of 15 to 23, the electrical terminal seal (10) having a base (12) and a cylindrical protrusion (14) integrally formed with the base (12) and extending from a major surface (16) of the base (12) and defining a cylindrical aperture (18) extending through the protrusion (14), **characterized in that** the protrusion (14) includes a first pair of circumferential ribs (20) integrally formed within the protrusion (14) and extending into the aperture (18) from an inner surface (22) of the protrusion (14), wherein the first pair of circumferential ribs (20) is in an interference fit with the terminal (106) to provide compressive contact with a cylindrical portion (108) of the terminal (106).

2. The electrical connector assembly according to claim 1, wherein the protrusion (14) is disposed within the terminal cavity (104) and wherein the electrical terminal (106) is disposed within the aperture (18).
3. The electrical connector assembly according to claim 1 or 2, wherein the first pair of circumferential ribs (20) is in an interference fit with the cylindrical portion (108) of the electrical terminal (106).
4. The electrical connector assembly according to any one of the preceding claims, wherein seal further includes a second pair of circumferential ribs (24) integrally formed with the protrusion (14) and extending from an outer surface (26) of the protrusion (14) and wherein the second pair of circumferential ribs (24) is in an interference fit with a wall (110) of the terminal cavity (104).
5. The electrical connector assembly (100) according to claim 1, wherein the aperture (18) is configured to receive an electrical terminal (106).
6. The electrical connector assembly (100) according to claim 4, wherein the second pair of circumferential ribs (24) is arranged on the outer surface (26) opposite a location of the first pair of circumferential ribs (20) on the inner surface (22).
7. The electrical connector assembly (100) according to claim 4 or 6, wherein the first pair of circumferential ribs (20) and the second pair of circumferential ribs (24) each have a circular segment cross section.
8. The electrical connector assembly (100) according to claim 4 or 6-7, wherein the protrusion (14), the first pair of circumferential ribs (20), and the second pair of circumferential ribs (24) are formed of the silicone rubber material.
9. The electrical connector assembly (100) according to any one of the preceding claims, wherein the electrical terminal seal (10) includes a plurality of the protrusion (14).
10. The electrical connector assembly (100) according to any one of the preceding claims, wherein a first portion (28) of the plurality of the protrusion (14) has a different diameter than a second portion (28) of the plurality of the protrusion (14).
11. The electrical connector assembly (100) according to any one of the preceding claims, wherein the silicone rubber material has a Shore A durometer value in a range of 18 to 20.
12. The electrical connector assembly (100) according to claim 11, wherein the silicone rubber material has

a Shore A durometer value of 18.

Patentansprüche

1. Elektrische Steckverbinderanordnung (100), umfassend:

ein Verbindergehäuse (102), das einen zylindrischen Anschlusshohlraum (104) definiert; einen elektrischen Anschluss (106), der einen zylindrischen Abschnitt (108) aufweist; und eine Dichtung (10) für einen elektrische Anschluss, die aus einem selbstentlüftenden Silikonkummi ausgebildet ist, das einen niedrigen Druckverformungsrest mit einem Shore-A-Durometerwert in einem Bereich von 15 bis 23 aufweist, wobei die Dichtung (10) für den elektrischen Anschluss eine Basis (12) und einen zylindrischen Vorsprung (14) aufweist, der einstückig mit der Basis (12) ausgebildet ist und sich von einer Hauptfläche (16) der Basis (12) erstreckt und eine zylindrische Öffnung (18) definiert, die sich durch den Vorsprung (14) erstreckt, **dadurch gekennzeichnet, dass** der Vorsprung (14) ein erstes Paar Umfangsrippen (20) beinhaltet, das einstückig innerhalb des Vorsprungs (14) ausgebildet ist und sich von einer Innenfläche (22) des Vorsprungs (14) in die Öffnung (18) erstreckt, wobei das erste Paar Umfangsrippen (20) in einer Presspassung mit dem Anschluss (106) steht, um einen Druckkontakt mit einem zylindrischen Abschnitt (108) des Anschlusses (106) bereitzustellen.
2. Elektrische Steckverbinderanordnung nach Anspruch 1, wobei der Vorsprung (14) innerhalb des Anschlusshohlraums (104) angeordnet ist und wobei der elektrische Anschluss (106) innerhalb der Öffnung (18) angeordnet ist.
3. Elektrische Steckverbinderanordnung nach Anspruch 1 oder 2, wobei das erste Paar Umfangsrippen (20) in einer Presspassung mit dem zylindrischen Abschnitt (108) des elektrischen Anschlusses (106) steht.
4. Elektrische Steckverbinderanordnung nach einem der vorhergehenden Ansprüche, wobei die Dichtung ferner ein zweites Paar Umfangsrippen (24) beinhaltet, das einstückig mit dem Vorsprung (14) ausgebildet ist und sich von einer Außenfläche (26) des Vorsprungs (14) erstreckt, und wobei das zweite Paar Umfangsrippen (24) in einer Presspassung mit einer Wand (110) des Anschlusshohlraums (104) steht.
5. Elektrische Steckverbinderanordnung (100) nach

Anspruch 1, wobei die Öffnung (18) dazu konfiguriert ist, einen elektrischen Anschluss (106) aufzunehmen.

6. Elektrische Steckverbinderanordnung (100) nach Anspruch 4, wobei das zweite Paar Umfangsrippen (24) auf der Außenfläche (26) gegenüber einer Position des ersten Paares Umfangsrippen (20) auf der Innenfläche (22) angeordnet ist. 5
7. Elektrische Steckverbinderanordnung (100) nach Anspruch 4 oder 6, wobei das erste Paar Umfangsrippen (20) und das zweite Paar Umfangsrippen (24) jeweils einen kreissegmentförmigen Querschnitt aufweisen. 10
8. Elektrische Steckverbinderanordnung (100) nach Anspruch 4 oder 6-7, wobei der Vorsprung (14), das erste Paar Umfangsrippen (20) und das zweite Paar Umfangsrippen (24) aus dem Silikonkautschukmaterial ausgebildet sind. 15
9. Elektrische Steckverbinderanordnung (100) nach einem der vorhergehenden Ansprüche, wobei die elektrische Anschlussdichtung (10) eine Vielzahl der Vorsprünge (14) beinhaltet. 20
10. Elektrische Steckverbinderanordnung (100) nach einem der vorhergehenden Ansprüche, wobei ein erster Abschnitt (28) der Vielzahl der Vorsprünge (14) einen anderen Durchmesser aufweist als ein zweiter Abschnitt (28) der Vielzahl der Vorsprünge (14). 25
11. Elektrische Steckverbinderanordnung (100) nach einem der vorhergehenden Ansprüche, wobei das Silikonkautschukmaterial einen Shore-A-Durometerwert in einem Bereich von 18 bis 20 aufweist. 30
12. Elektrische Steckverbinderanordnung (100) nach Anspruch 11, wobei das Silikonkautschukmaterial einen Shore-A-Durometerwert von 18 aufweist. 35

Revendications

1. Ensemble connecteur électrique (100), comprenant : 40
 - un boîtier de connecteur (102) définissant une cavité de terminal cylindrique (104) ;
 - un terminal électrique (106) ayant une partie cylindrique (108) ; et
 - un joint d'étanchéité de terminal électrique (10) formé d'un caoutchouc de silicone à faible compression et auto-purge ayant une valeur de duromètre Shore A comprise dans une plage de 15 à 23, le joint d'étanchéité de terminal électrique (10) ayant une base (12) et une saillie cy-

lindrique (14) formée d'un seul tenant avec la base (12) et s'étendant à partir d'une surface principale (16) de la base (12) et définissant une ouverture cylindrique (18) s'étendant à travers la saillie (14), **caractérisé en ce que** la saillie (14) comporte une première paire de nervures circonférentielles (20) formées d'un seul tenant à l'intérieur de la saillie (14) et s'étendant dans l'ouverture (18) à partir d'une surface interne (22) de la saillie (14), dans lequel la première paire de nervures circonférentielles (20) est en ajustement serré avec le terminal (106) pour fournir un contact compressif avec une partie cylindrique (108) du terminal (106).

2. Ensemble connecteur électrique selon la revendication 1, dans lequel la saillie (14) est disposée à l'intérieur de la cavité de terminal (104) et dans lequel le terminal électrique (106) est disposé à l'intérieur de l'ouverture (18).
3. Ensemble connecteur électrique selon la revendication 1 ou 2, dans lequel la première paire de nervures circonférentielles (20) est en ajustement serré avec la partie cylindrique (108) du terminal électrique (106).
4. Ensemble connecteur électrique selon l'une quelconque des revendications précédentes, dans lequel le joint d'étanchéité comporte également une seconde paire de nervures circonférentielles (24) formées d'un seul tenant avec la saillie (14) et s'étendant à partir d'une surface externe (26) de la saillie (14) et dans lequel la seconde paire de nervures circonférentielles (24) est en ajustement serré avec une paroi (110) de la cavité de terminal (104).
5. Ensemble connecteur électrique (100) selon la revendication 1, dans lequel l'ouverture (18) est configurée pour recevoir un terminal électrique (106).
6. Ensemble connecteur électrique (100) selon la revendication 4, dans lequel la seconde paire de nervures circonférentielles (24) est disposée sur la surface externe (26) à l'opposé d'un emplacement de la première paire de nervures circonférentielles (20) sur la surface interne (22).
7. Ensemble connecteur électrique (100) selon la revendication 4 ou 6, dans lequel la première paire de nervures circonférentielles (20) et la seconde paire de nervures circonférentielles (24) présentent chacune une section transversale de segment circulaire.
8. Ensemble connecteur électrique (100) selon la revendication 4 ou 6 et 7, dans lequel la saillie (14), la première paire de nervures circonférentielles (20) et la seconde paire de nervures circonférentielles (24)

sont formées d'un matériau en caoutchouc de silicone.

9. Ensemble connecteur électrique (100) selon l'une quelconque des revendications précédentes, dans lequel le joint d'étanchéité de terminal électrique (10) comporte une pluralité de saillies (14). 5
10. Ensemble connecteur électrique (100) selon l'une quelconque des revendications précédentes, dans lequel une première partie (28) de la pluralité de saillies (14) présente un diamètre différent de celui d'une seconde partie (28) de la pluralité des saillies (14). 10
11. Ensemble connecteur électrique (100) selon l'une quelconque des revendications précédentes, dans lequel le matériau en caoutchouc de silicone a une valeur au duromètre Shore A comprise dans une plage de 18 à 20. 15 20
12. Ensemble connecteur électrique (100) selon la revendication 11, dans lequel le matériau en caoutchouc de silicone a une valeur au duromètre Shore A de 18. 25

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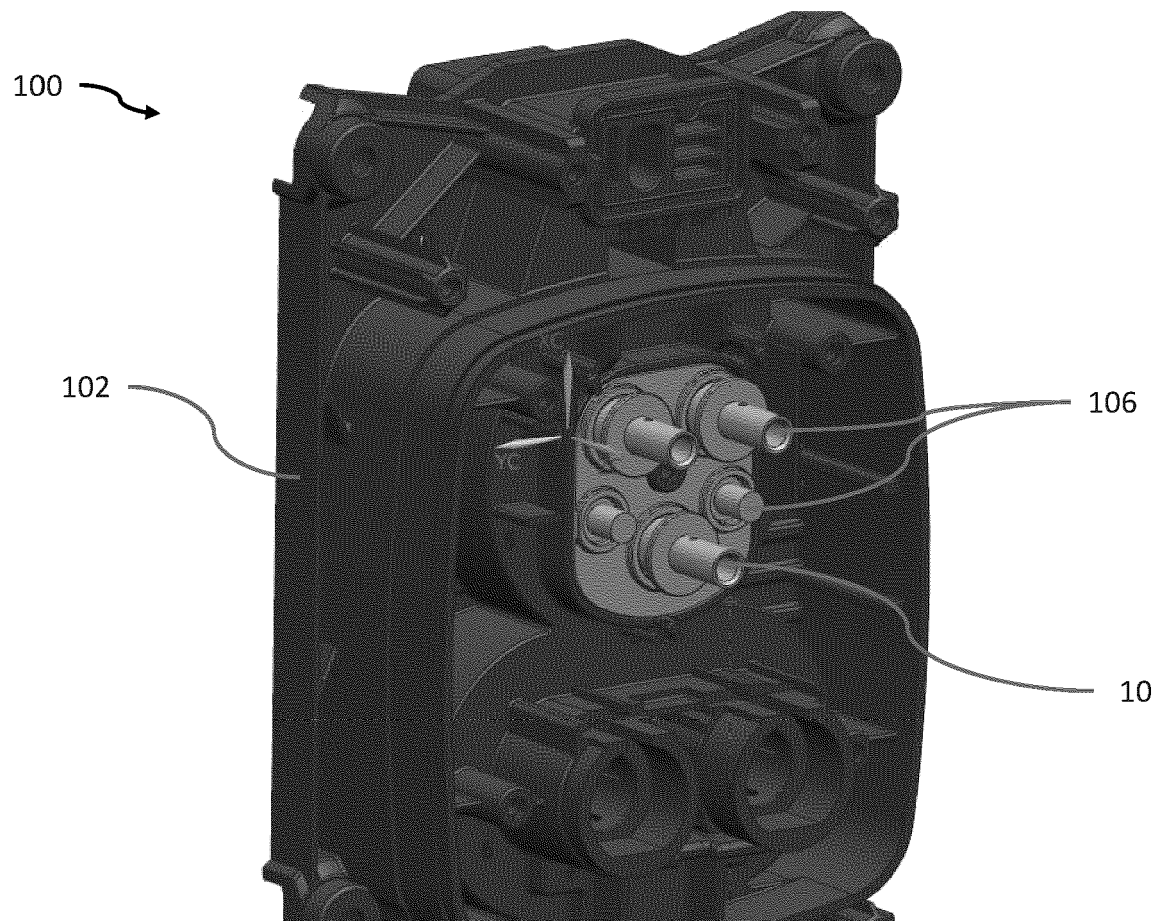


FIG. 1

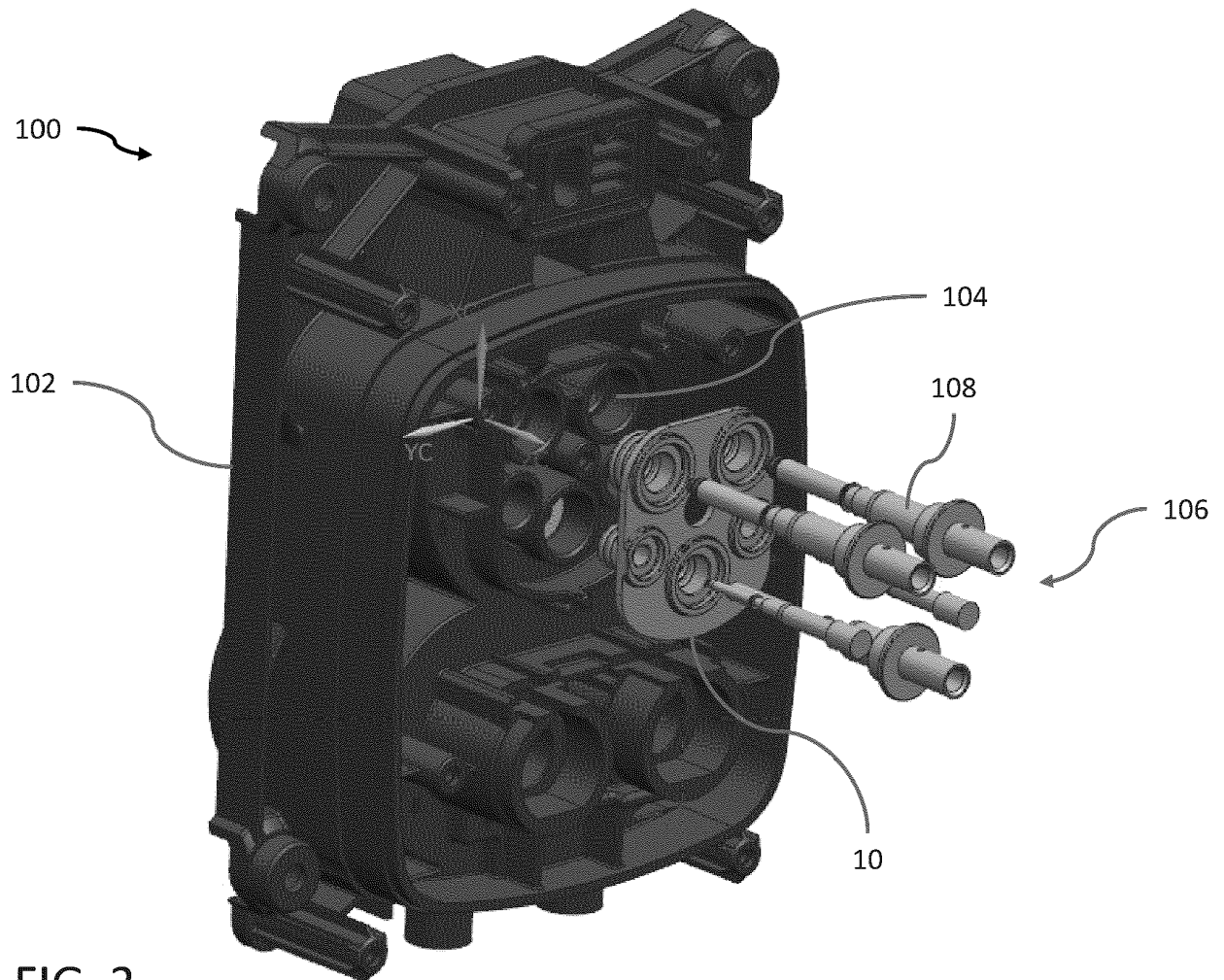


FIG. 2

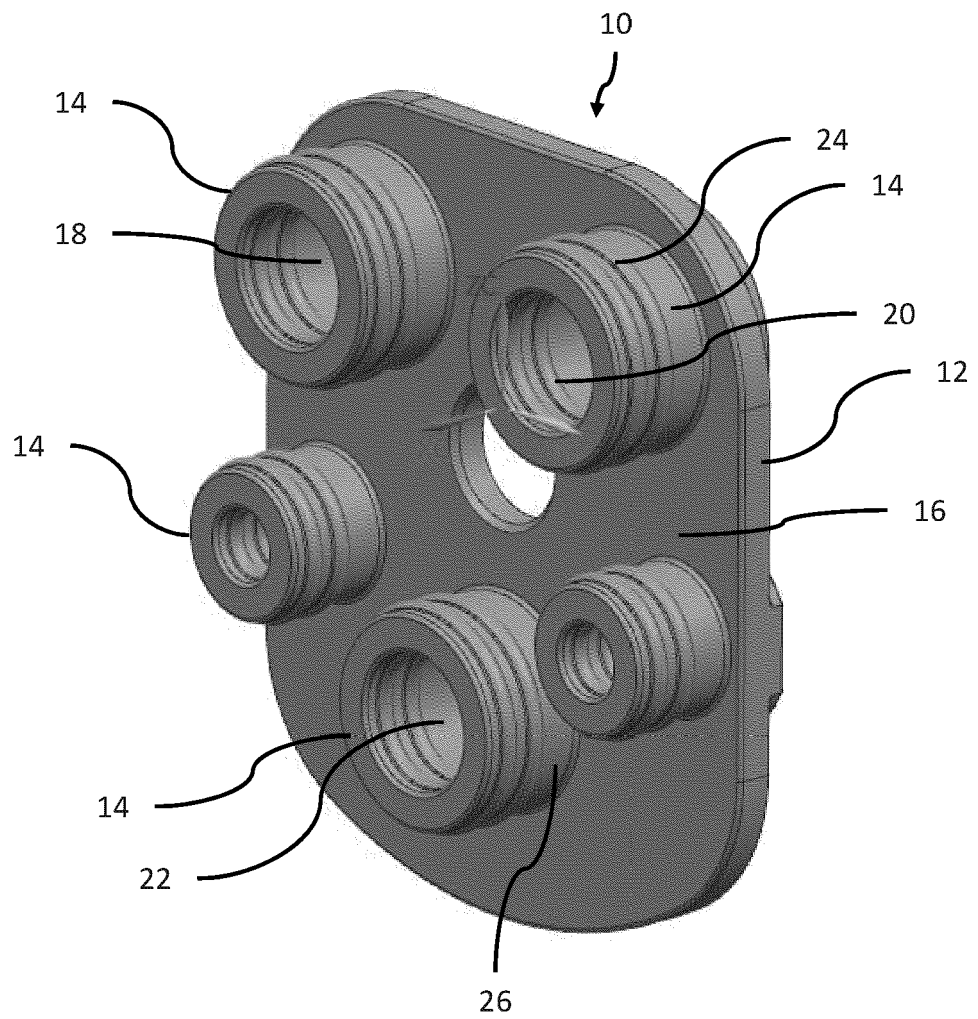
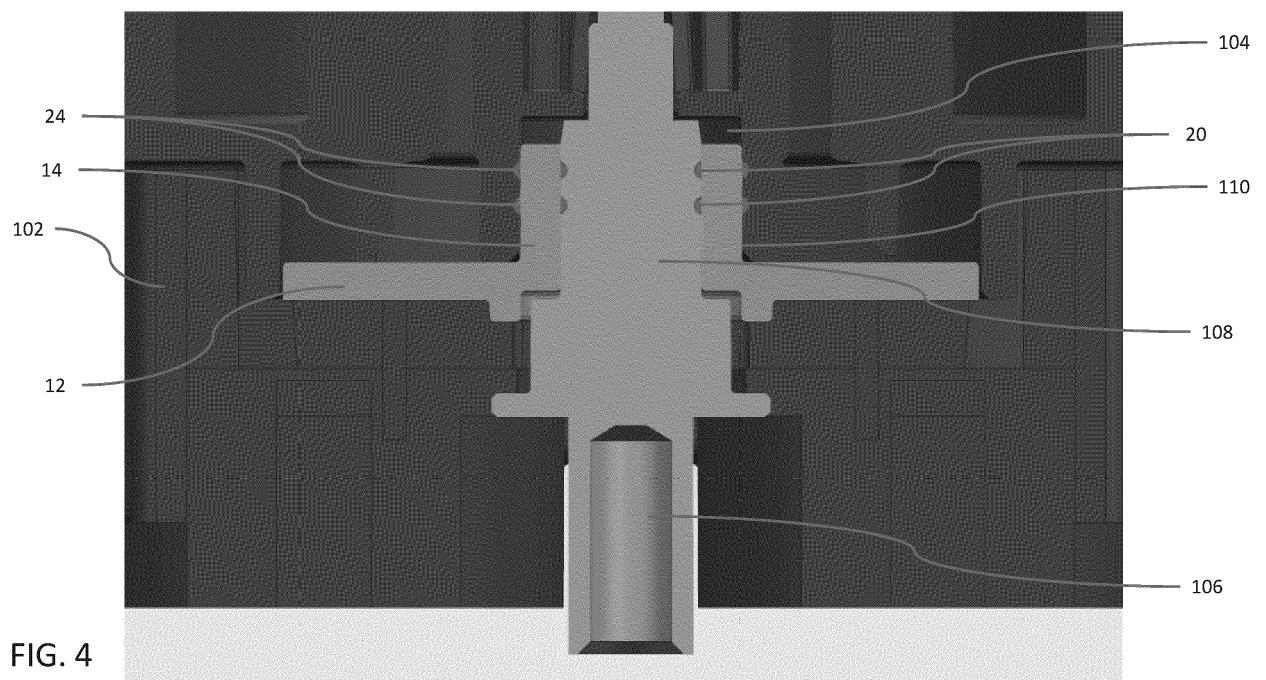


FIG. 3



REFERENCES CITED IN THE DESCRIPTION

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